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THE GOVERNMENT'S RESPONSIBILITIES IN SCIENCE[1]

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THE range of opportunity in science in this country is so great and the extent to which the government should undertake responsibility in this field involves such complex considerations that it is perhaps rash to undertake a discussion of the problem. Nevertheless, the problem is as important as it is complex and events of the last two years have conspired to focus on it the attention of several organized groups of scientists with the result that some aspects at least of the problem have been somewhat clarified. I will attempt, therefore, to give a brief sketch of the problem of the government's present responsibilities in science, together with some suggestions as to ways in which these responsibilities may profitably be extended as they have been developed through discussions in the Science Advisory Board and in conferences with many other agencies and individuals.

[1] Address given on March 16 at the initiation banquet of the Yale Chapter of Sigma Xi.

My own contact with this study dated from a radiogram from my assistant, received in the summer of 1933 while on the boat from Boston to Bangor, stating: "Word received that you have been appointed chairman of committee to reorganize Federal Government." Realizing that there was some major misunderstanding, I was naturally interested to learn what had really happened and found in the paper on the following day that the President had appointed a Science Advisory Board of scientists and engineers with authority "to appoint committees to deal with specific problems in the various departments."

This board now consists of fifteen men, including: Dr. Campbell, president of the National Academy of Sciences; Dr. Bowman, chairman of the National Research Council; Dr. Dunn, president of the J. G. White Engineering Corporation; Dr. Jewett, president of the Bell Telephone Laboratories; Dr. Kettering, president of the General Motors Research Corporation; Dr.

Leith, professor of geology at the University of Wisconsin; Dr. Merriam, president of the Carnegie Institution of Washington; Dr. Millikan, director of the Norman Bridge Laboratory of Physics, California Institute of Technology; Dr. Adams, professor of organic chemistry and president of the American Chemical Society; Dr. Flexner, director of the Rockefeller Institute for Medical Research; Dr. Jones, professor of plant pathology at the University of Wisconsin; Dr. Lillie, dean of the Division of the Biological Sciences of the University of Chicago; Dr. Rosenau, professor of preventive medicine and hygiene at the Harvard Medical School and professor of epidemiology at the Harvard School of Public Health; Dr. Parran, state commissioner of health of New York.

I discuss the work of this Science Advisory Board with some hesitation on two grounds. In the first place, your distinguished president, Dr. Angell, is reported in the press to have raised a question as to whether the services to government by members of educational institutions may not sometimes be of less public value than their regular services in their institutions. You have probably heard the remark attributed to President Nicholas Murray Butler in commenting on the large exodus of Columbia University professors to government posts: "Columbia's loss is the nation's loss." In the second place, there are those who feel that the efforts of well-meaning experts to assist the country, through their services to the government in these times of distress, have not all been well considered or successful. Some of them are unfortunately analogous to the attempt to relieve the darky who had swallowed a potato bug by administering to him a large dose of Paris green to kill the potato bug.

However these things may be, the Science Advisory Board has found certain directions of usefulness in a modest way, and through its consideration of problems of the scientific services of the government has formulated the broad outlines of a plan whereby the scientific forces of the country may be strengthened and put to work more effectively for the national welfare. Before discussing this plan it will be helpful first to see where the government now fits into the picture of scientific activities of the country.

The scientific services of the government are spread through forty federal bureaus, of which eighteen can be called primarily scientific. Although their operations involve only about half of one per cent. of the federal budget, their work is absolutely essential to the national welfare in agriculture, manufacture, commerce, health and safety.

Typical problems in the administration of these bureaus are: Is the organization adapted to the best fulfilment of its objectives? Are its objectives of distinct importance for the public welfare? Is its program planned with vision and keen appreciation of needs and opportunities? Are old projects dropped when their objectives have been attained? Is the personnel competent and alert? Is there proper coordination and cooperation with non-governmental agencies? Are the most up-to-date methods in use? Is there unwise duplication of effort? Should a given project be handled by a governmental bureau or left to non-governmental agencies? What is the best expert advice on a given problem of public interest?

Problems like these are always present and require constant attention if the government's scientific work is to be maintained on a plane of high efficiency. Disinterested and competent advice is desired on occasions by the secretaries of departments, and similar advice and help are useful to the chiefs of bureaus.

The following three steps have been taken by the Federal Government to provide for itself disinterested and competent advice upon scientific matters:

(1) The National Academy of Sciences was established by an Act of Incorporation "enacted by the Senate and House of Representatives of the United States of America in Congress assembled," and approved by President Lincoln on March 3, 1863, said act specifying that "The Academy shall, whenever called upon by any Department of the Government, investigate, examine, experiment and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments and reports to be paid from appropriations which may be made for the purpose," subject to the condition that "the Academy shall receive no compensation whatever for any service to the Government of the United States."

(2) The National Research Council was organized in 1916, at the request of President Wilson, by the National Academy of Sciences under its congressional charter, as a measure of national preparedness, and perpetuated by the National Academy of Sciences on April 29, 1919, at the President's further request, as expressed in Executive Order No. 2859. The National Research Council is, in a sense, an operating arm of the National Academy of Sciences and is permanently organized into divisions, with representatives from all major scientific bodies, to further the interests of science and technology within and without the government.

(3) The Science Advisory Board was created by President Roosevelt by Executive Order No. 6238, July 31, 1933 (supplemented by Executive Order No. 6725, May 28, 1934) "with authority, acting through the machinery and under the jurisdiction of the National Academy of Sciences and the National Research Council, to appoint committees to deal with specific

problems in the various departments," with terms of appointment to expire on July 31, 1935.

The appropriations for the scientific bureaus of the government have been greatly reduced since the affluent days just preceding the depression, by amounts ranging in some bureaus as high as 60 per cent. According to Mr. Ralph Ward the 1935 budget shows the following appropriations for scientific work:

10 bureaus in the Department of Agriculture	$38,276,000
5 bureaus in the Department of Commerce	11,522,000
2 bureaus in the Department of Interior	1,232,000
8 bureaus in the Navy Department	3,918,000
1 bureau in the Treasury Department	9,313,000
6 bureaus in the War Department	4,503,000
Nat'l Advisory Com. for Aeronautics	1,453,000
Smithsonian Institution	864,000

These figures include only expenditures for scientific work, except in the Department of Agriculture, where they include all appropriations to the bureaus, since it is difficult there to separate the scientific work from other activities.

Taking the appropriations which go definitely for science, it is found that only about .3 of one per cent. of the total budget of the Federal Government goes into scientific work. In comparison with the importance of scientific work to the country, this is certainly not a large proportion. One might well raise the question as to whether an increase in this amount might not bring advantages to the country which are large in comparison with those resulting from many of the other far larger expenditures.

It is interesting to consider these expenditures against the total background of expenditures for scientific work in the country from all sources. Mr. Watson Davis, editor of Science Service, has estimated the total national expenditure for work in science by government, industry, foundations and universities to be somewhat less than $100,000,000 per year. It is seen, therefore, that the Federal Government accounts for roughly half of the total national expenditure for science.

It is also interesting to consider the part played by the universities from the standpoint of expenditures for science. The U. S. Office of Education Pamphlet No. 58 gives the following statistics for the academic year 1934–1935: 81 publicly controlled universities and colleges, with a total budget of $81,774,000, reported $9,526,000 as appropriated for research work. The major portion of these appropriations were for agriculture. Of the 81 institutions here listed only 47 reported any appropriations for research. Of 219 privately controlled educational institutions with aggregate budgets of $57,600,000, practically all the research funds were reported by 16 of these institutions, and their aggregate expenditures for organized research were $1,627,000. It is evident from these figures that, important as research in educational institutions may be in developing new knowledge, their total expenditures for research are very much less than are the expenditures of the Federal Government for scientific work. It must be remembered of course that most of the government's expenditures for scientific work are not for research but rather for the accumulation of scientific and technical data or the administration of technical services.

It is of interest to note the part played by the philanthropic foundations in this whole program. Dr. Keppel, in an address at Brown University last year, stated that in 1931 the philanthropic foundations of the country distributed $54,000,000, of which about $10,000,000 were for encouragement of research, exclusive of the very important fields of medicine and public health. Taking two of the largest of these foundations as examples, we note that the Carnegie Corporation in 1933 made grants of $68,000 for scientific research in the United States, and its scientific agency, the Carnegie Institution of Washington, reported total expenses of $1,576,000. Similarly, the Rockefeller Foundation in 1933, out of total appropriations and expenditures of $14,754,000, made appropriations of $4,509,000 for the natural and medical sciences and public health.

It is of course extremely difficult to justify the accuracy of these figures because of the differences in manner of reporting, but certain general conclusions can safely be drawn. The Federal Government is by a very large margin the largest scientific agency in the country. The next largest single unit consists of the agricultural work of the land-grant colleges and universities. Excluding these the aggregate expenditures for scientific research by the universities of the country are comparable with the expenditures of the philanthropic foundations for these purposes. (As stated above, these conclusions are necessarily very rough. A major uncertainty lies in the definition of scientific work. If the expenditures of universities for *educational* work in science had been included, their position would of course appear much more prominently in the financial comparison).

With this general background showing the distribution of scientific work in the country, let me now turn to a description of some typical problems of the federal scientific services which have engaged the attention of the Science Advisory Board and its committees during the past two years.

The first problem submitted to the board was a request by the Secretary of Agriculture for a study of the U. S. Weather Bureau and recommendations for improving its service. There had long been recogni-

tion of economic and other advantages which would result if the accuracy of weather forecasting and of other meteorological data could be improved. The issue may have been forced by a critical survey and report of the Weather Bureau by a committee of the American Society of Civil Engineers and by the disaster to the airship *Akron*. The board's study of the Weather Bureau disclosed the enormous service to the public which this bureau has rendered per dollar of taxpayers' money which has gone into the service as a result of efficient organization and particularly because of the friendly contribution of services by an enormous number of voluntary meteorological observers organized by and cooperating with the Weather Bureau. It was evident, however, that a new technique of weather forecasting, based on "air mass analysis" and which originated in the Scandinavian countries, has proven to be superior to the older method now in use by the bureau which was based essentially on a systematic study of precedence in weather maps. The air mass analysis method is a three-dimensional rather than a two-dimensional study of the atmosphere and therefore involves the use of meteorological data taken at high altitudes as well as those taken on the surface of the ground. The atmosphere is like a huge ocean with cold currents coming down from the north, warm, humid currents flowing up from the region of the Caribbean, and a third current flowing in from the Pacific. These currents are like great rivers, or like the Gulf Stream, in the atmosphere, and follow more or less well-defined but continuing varying paths over the country. Storms and quick changes of temperature occur where they meet. Tests on the Atlantic Coast by the Massachusetts Institute of Technology, and on the Pacific Coast by the California Institute of Technology and some years of use by the military services have demonstrated the improved accuracy of this new method. While greater accuracy is valuable for all human activities which depend on the weather, and economically important, particularly in the handling and transportation of foodstuffs and live-stock, it is the requirements of modern commercial aviation which have rendered acute the problem of greater accuracy in weather forecasting.

We found that all the governmental agencies involved were anxious to cooperate in any movement which might improve the work of the Weather Bureau. The Army and the Navy offered to assign some of their airplanes, used in practice flying, for the purpose of taking up to high altitudes the self-recording meteorological instruments needed to secure the data on temperature, pressure and humidity, and to do this at strategically located stations over the country. The Bureau of Aeronautics in the Department of Commerce agreed to cooperate more closely with the Weather Bureau in unifying the communication system for transmitting meteorological data. The board therefore recommended the adoption of the air mass analysis method of forecasting, together with other important improvements, such as increasing from two to three, and if possible 4, the number of daily weather maps, the attaining of an increased amount of meteorological information from the region of the Caribbean Sea in which destructive hurricanes have their origin, and the closer inspection of meteorological stations.

These recommendations have been adopted and are being put into effect as rapidly as circumstances permit. The major difficulties to be overcome are, first, the retraining of personnel to use the new method, which will take a minimum of five years and which involves some knotty problems of internal administration, and second, some increase in the annual appropriations to the Weather Bureau, which can be unquestionably defended on the ground of large economic return to the country but which are difficult to obtain in these times of anxiety over federal expenditures, and which have not yet been granted by Congress.

Another great and essential scientific service of the Federal Government is the National Bureau of Standards, through which are maintained those scientific and technical standards which form the very basis of modern manufacturing methods, as well as of scientific and technical work generally. A peculiarly acute problem faces the Bureau of Standards because of the following situation, which is over and above the problem of decreased budgets which has faced the scientific services generally.

Because of the nature of the Bureau of Standards, it has been found to serve a useful purpose in setting the specifications for the purchase of all kinds of materials by federal agencies, such as army blankets, trucks for the Post Office Department, thermometers for the Veterans' Hospitals and thousands of similar items. Having set these specifications, it is then necessary for the government to test its purchased materials to find out whether they meet the specifications, and here again the Bureau of Standards has been found the most convenient, and in fact, the only government agency set up to make such tests. Consequently, a very large portion of the work of the bureau has come to be the testing of purchased materials for other branches of the government, although this work was not contemplated or provided for in the organic act which created the bureau. As a matter of fact, nearly half of the budget of the Bureau of Standards is required to carry on such work.

When the severe reductions in appropriations to government bureaus were made for the purpose of balancing the federal budget, the total appropriations to the bureau were cut nearly 50 per cent. It was impossible, however, for the bureau to reduce its ex-

penditures for these government testing services because the government was continuing to purchase materials even on an increased scale. The fact that the bureau has had to continue this work undiminished has resulted in its crowding out of a large portion of the proper work of the bureau for which it was originally established, and this work, as a matter of fact, has had to be reduced at least 70 per cent. The problem of the Bureau of Standards has therefore been one of the most severe of any of the federal bureaus.

Three agencies have combined to make a joint study of this situation, the Science Advisory Board, the Visiting Committee of the Bureau of Standards, which was set up by Act of Congress, and the Committee of the Bureau of Standards of the Business Advisory and Planning Council of the Department of Commerce. This joint committee has made a detailed study of the activities and problems of the bureau and has recommended that certain activities be dropped, that others be transferred to non-governmental agencies where possible, that others be reduced for the time being and that still others be pushed forward and extended. Many of these recommendations have not been made because reduction or curtailment was desirable, but simply because curtailments *had* to be made somewhere because of the budget reduction.

The Secretary of the Interior asked the advice of the Science Advisory Board as to whether the Geological Survey and the Bureau of Mines should be combined or retained as separate bureaus. A study of the situation led to the recommendation that the bureaus should be maintained separately, though with minor readjustments of functions. There were two primary reasons for this recommendation, one that the objective and methods of the two bureaus were quite different, and the other that it would be difficult if not impossible to find one director for the combined services who would be sufficiently acquainted and sympathetic with both of them to prevent one or the other suffering from lack of leadership. At the same time the study disclosed a woeful inadequacy of statistical information in regard to minerals generally, and this at a time when such information is most urgently needed for the administration of the codes, of regulation of production and of tariffs and reciprocal trade agreements. It was therefore recommended that the agencies charged with collecting mineral statistics, which were spread over four bureaus in different departments, should be consolidated into one bureau of mineral economics and statistics. I am glad to say that these recommendations also have been adopted.

The Federal Coordinator of Transportation requested the Science Advisory Board to appoint a committee to cooperate with a committee of railroad presidents, for the purpose of finding out whether the railroads are making as effective use as possible of modern scientific and technical developments and to formulate a plan whereby the railroads may make as effective use as possible of such developments. This joint committee of leading railroad presidents and distinguished directors of industrial research has rendered its report in which broad policies for guiding and coordinating research work for the railroads were laid down. The results of this report are being crystallized in the newly formed Division of Planning and Research of the Association of American Railroads. There is no doubt but that the opportunities here are great and that the railroads are disposed to make every effort to utilize modern technology as effectively as possible, and it is perhaps fair to say that it is the human element in the situation, namely, the difficulty in finding properly qualified men to take charge of this work, which will be the limiting factor in the rate at which this program will be made effective.

One of the possible cures for the depression which has frequently been suggested is the creation of new industries, and the Secretary of Commerce has requested his Business Advisory and Planning Council and the Science Advisory Board to cooperate in recommending to him a program to this end. The assignment is a difficult one, for new industries are like babies—they need shelter and nourishment, which they take in the form of patent protection, financing and chance of reasonable profits. But, before all, they need to be born, and their parents are science and invention. Neither laws nor committees nor juggling acts can perform the necessary first step of conception. Also, like babies, new industries require time for growth. It is therefore evident that consideration of this problem involves stimulation of scientific research and engineering development, requires opportunities for financing and for the making of profits, which are rendered somewhat difficult under some of the more recent legislation, and requires a degree of patent protection which is difficult under our present system which is staggering along and almost swamped by the complexity of modern developments in the patent fields of types which were not contemplated when the patent law was originally drawn.

To cope with this situation the Science Advisory Board is making certain recommendations of government assistance in the stimulation of scientific work generally, and is submitting recommendations for certain modifications in patent procedure which should greatly improve the present situation without changing the general structure of patents. Some of the situations which these recommendations are designed to meet are the following.

The load on the Patent Office, from the enormous number of applications to patent all things from the trivial to the important, is such that adequate examination of prior art is impossible. For this reason the assurance of a patent does not now carry with it the proper validity and, in fact, I am told that over 65 per cent. of all patents which come up for litigation are declared invalid by the courts. The situation is so bad that it has come to be said that a patent is simply an invitation to sue.

A second difficulty lies in the time and expense and doubtful outcome of patent litigation. The expense has become so great that some large organizations are seriously questioning whether or not their research organizations are an economic gain or loss, and others are avoiding patents and seeking security in secrecy.

A third difficulty lies in the complexity of modern inventions, whereby a single product may involve a large number of different patents often held by different individuals. If any one of these individuals refuses to grant license under his patent, he may entirely block production of the product. It is this situation which has forced organizations to seek to acquire complicated patent monopolies which in turn have not been looked upon with favor by the courts. The situation is well-nigh an impossible one in its present form.

Through wide consultation and correspondence, a general consensus of opinion has been found in support of certain remedies for these situations, and these will soon be submitted to the secretary as a partial answer to his request for a plan for the stimulation of new industries.

One of the most far-reaching services of the government is its work in surveying and mapping. An accurate map of the United States is a prerequisite of all types of construction and planning. The standard map of the United States is less than half completed, and until the work is finished millions of dollars will be wasted in temporary and uncoordinated surveys which are found necessary by municipalities or states or construction agencies to handle their particular jobs. We are the only progressive nation in the world whose country has not been adequately surveyed and mapped.

There are more than twenty bureaus in the government which have mapping activities. The question has frequently been raised, "Should not these be consolidated?" This question has been investigated by the Science Advisory Board at the request of the Director of the Budget and a report with recommendations has been submitted to him. Among the interesting considerations are the following.

In some bureaus the production of maps is not a major objective, but maps are produced and used only as tools in the attainment of some other objective. In the case of other bureaus, however, the sole purpose of the bureau is to produce maps. As a basic principle it may be suggested that the tools should not be taken away from the people who need to use them. In other words, the subsidiary mapping services should not be consolidated into a federal bureau. On the other hand, a strong argument for efficiency can be made for the consolidation of those services whose sole objective is the production of maps. This argument is based upon efficient use of personnel the year round, elimination of duplication and uniform adoption of the most modern and efficient methods. On the other hand, there may be good reasons for the maintenance of separate units in several cases. For example, in the military services, military necessity or secrecy or the maintenance of a staff under immediate military control may be important factors.

This question has been frequently discussed by previous commissions and before Congress, and there are amusing illustrations of arguments pro and con which have been invented to impress Congress without adequate basis of fact. From the standpoint of national efficiency it is highly important that some action should be taken, but any action which involves the transfer of established bureaus meets with a type of opposition which is politically difficult to overcome. We very much hope that the present effort may meet with a degree of success which has been denied the more than a dozen previous efforts which have been made to effect an improvement in this field.

It has been very difficult to secure an unbiased opinion regarding the economic possibilities of mineral development in the region of Boulder Dam with the utilization of the electric power there developed. Perhaps because of the great industrial and political interests involved, the Science Advisory Board was called upon as a disinterested body to make a survey and report on this matter. This work was carried out in three steps: first, a factual survey by the Geological Survey of the extent, grade and accessibility of the mineral deposits within reach of electric power of the Boulder Dam; second, a determination of the cost of production of the various products obtainable from these mineral deposits; and third, a consideration of such economic features as transportation costs to the point of demand and the effect of such production on similar industries in other localities. The result of this study has been the publication by the Department of the Interior of a factual analysis from which can be selected those products which can profitably be developed and those other products whose development at the present time would be economically impossible or undesirable in competition with other sources of supply.

The Department of Agriculture carries on more scientific work than any of the other departments. This work is found in about ten out of the eighteen bureaus of the department. Many of these bureaus are almost independent organizations and there is a considerable amount of duplication of effort and of facilities. Some of this duplication is necessary to the efficient performance of work, while in other cases a more effective coordination would undoubtedly be advantageous. The Secretary of Agriculture requested the Science Advisory Board to give particular attention to the Bureau of Chemistry and Soils in its relation to the chemical work of other bureaus. It has sometimes been suggested that all chemical work of the government should be concentrated in one comprehensive bureau of chemistry. On the other hand, it is pointed out that chemistry is frequently a tool which is needed by a worker in some other field where the objective is not primarily chemical in nature. It is obviously a very difficult matter to ascertain that most effective degree of consolidation or the best type of coordination of such work. A distinguished committee has been giving attention to this problem, bringing in the benefit of the best industrial experience as well as expert knowledge of chemistry. This committee has found certain difficulties which are peculiar to the government organization and which probably preclude an ideal solution to the problem. In view, however, of the millions of dollars which are spent on research in this department, it is decidedly to the public interest to see that this work is being done with the maximum effectiveness, and the officials of the department are cooperating with the committee in an effort to find a solution which will be as nearly ideal as possible and at the same time practicable within the limitations of government operation.

These illustrations, taken from the varied activities of the Science Advisory Board, will show something of the interest as well as the complexity of the government's work in the varied fields of science. Beyond these particular services attached to existing bureaus, there lies, however, an immense field of government responsibility in which science plays or may play a prominent part, and I would next comment briefly upon the opportunities and responsibilities which the government may have in this larger field.

There are important national problems like insanity, crime, public works, unemployment, excess agricultural production, land use and power utilization, which are of great concern to government but for which the responsibility extends beyond the jurisdiction of governmental bureaus to states, municipalities and to the people as a whole. They involve considerations of care, relief, control and management which are the subject of governmental action involving enormous expenditures. They are the concern of the social scientists in order that this care, relief, control and management may be wisely conceived and administered. But they should also be the concern of the natural scientists in two main aspects: first, to ascertain the facts which are susceptible of scientific observation or measurement, in order to supply social scientists and government with data essential to their activities; second, to alleviate or cure the difficulties where this is possible by applications of science, as illustrated below.

The magnitude of the purely economic aspect of these problems is realized by very few people. In the case of mental illness alone, approximately 20 per cent. of the state budgets goes to care of the mentally diseased. Past experience and present knowledge both indicate that science will probably succeed in alleviating or partially curing all these difficulties if given adequate time and opportunity. It is obviously in the public interest, therefore, that this opportunity should be given and that this should be done as rapidly as the scientists themselves are able to handle the opportunity. As an investment for the future, or an insurance against future expenditures, and at the same time as a social obligation, the government has a great responsibility in seeing to it that work along these lines is pushed as vigorously as possible. The Science Advisory Board is prepared to cooperate with other agencies in pointing out this responsibility and urging that the government accept it.

If time permitted it would be possible to analyze these problems in greater detail and to submit specific programs for work in pure and applied science whose social value is unquestioned and which can be laid out with some degree of assurance on the basis of present knowledge. I would simply mention, by way of illustration, such matters as tropical diseases, long-range weather forecasting, development of new and improved uses of electric power, discovery of new uses for agricultural products, elimination of specific hazards in navigation, etc.

It is interesting and somewhat disheartening to note that our country, with all its boasted progressiveness, has paid less official attention to science as a means of combatting our present difficulties than any of the other great powers.

Russia, seeing what science has done in raising the standard of living in other countries—especially in our own country—is centering her whole economic program on science. She has used, as the central feature of this program, the Academy of Science, founded by Peter the Great. Under this have been established more than two hundred great research institutes for work in pure science and engineering. Her annual appropriations for these institutes are reported to be

larger than any other items in her budget—even the military and defense item.[2] Many of her scientific laboratories rank among the best-equipped laboratories in the world at the present time. Though short of trained workers, they are already turning out some first-class work, and a well-considered program of selecting and training research workers has been instituted.

Great Britain also has taken decisive steps to utilize science for social and economic improvement, despite the fact that she was harder hit than we by the war, her unemployment crisis came sooner, her taxes are higher. She has called her leading scientific men to advise her privy council on scientific and technical policies, through three advisory councils composed of Britain's most noted scientists. It is on advice of these councils that the programs and budgets of the government's scientific bureaus are determined. The government, furthermore, appropriates about a million pounds annually, to be used for research. On advice of the advisory council, appropriations are made to governmental scientific bureaus and grants for research are made to educational institutions and scientific societies; also for research fellowships, and for support of industrial research by trade associations, provided these associations match the grants with similar contributions from their own funds. In this latter way, programs of research have been inaugurated in twenty-one of the most important industrial associations.

Italy has mobilized her research facilities in a broad-scale effort to rehabilitate her economic position, and to counteract her deficiency in raw materials through application of her "brain power" to the most effective use of what she has. The government has appropriated large sums for the better equipment of university research laboratories and all work in these institutions and in governmental laboratories is supervised by a National Research Council. Furthermore, no governmental financial assistance is given to industries unless this Research Council certifies that the industry maintains a progressive policy of research and development.[3]

Until recently Germany led the world in her sustained efforts to maintain a strong economic position through scientific research, notably in the fields of chemistry and metallurgy. Every one knows the success of this policy, until it was largely wrecked by other circumstances. Her scientific strength, however, is still probably Germany's strongest economic asset.

Japan, for years, has been bending every effort to introduce western technology into her industrial procedures. Begun as a policy of copying technical processes and products which had been developed elsewhere, it was accompanied by an intensive program of scientific education of her own scholars. She is now in a position to lead as well as to follow in scientific work of high quality, and this is bearing fruit in her industrial position.

Compare this picture with that of our own country. As soon as we got into trouble we cut our governmental expenditures for scientific work *more* severely than those of any other government activity. We gave no consideration either to unemployed scientists or to the public value of their work in our emergency measures for relief of unemployment or for economic rehabilitation. And yet we have prided ourselves as being the most advanced nation on earth!

The truth is that we have been fortunate enough to have great natural resources, which we have exploited riotously; we have had a pioneering spirit which has bred some great inventors; this same pioneering spirit has developed some industrial giants who have plunged into big things and have brought "quantity production" into operation; we have been blessed with a few great philanthropists whose altruistic vision has led them generously to support scientific work and other activities for human welfare in universities and other private institutions. But, as a people and therefore as reflected in our national policies, we have been more lucky than intelligent. Now that we are no longer able to thrive on the unrestricted exploitation of the gifts of nature, it is imperative that we take steps to utilize our resources more intelligently and effectively, and this means scientific research on an increasing scale.

In conclusion, it seems to me that what is needed is a bilateral program for putting science to work for the national welfare. There is needed on the one side the cooperation of the scientists of the country generally, to assist the government in putting the work of its scientific bureaus on a scale of maximum efficiency and value. There is needed on the other hand a new type of government leadership whereby the scientific men of the country may be brought together to make an intelligent and coordinated attack on the great problems which are facing the country at those points at which science may offer hope of alleviation or solution.

Under these circumstances it seems to me certain that scientists will have to play an even more important rôle in the future than in the past. The problems to be solved are more complex, greater intelligence is

[2] Report by Dr. Julius F. Hecker, of Moscow University, who was sent to the United States to arrange for a system of exchange research professorships between the United States and the U. S. S. R.

[3] Report by Mr. Maurice Holland, director of the Division of Engineering and Industrial Research of the National Research Council, following his recent study of conditions in Italy.

needed in handling them, the scientific approach rather than the political or opportunistic approach is demanded. Whether directly in the government service or indirectly in universities or industries of the country, there is no doubt but that men of the type found in the Society of Sigma Xi will find ample scope for their best efforts and in those efforts they will find careers of usefulness and of satisfaction.

OBITUARY

JOHN JAMES RICKARD MACLEOD

JOHN JAMES RICKARD MACLEOD, M.B., Ch.B., D.Sc. (University of Toronto 1923, University of Pennsylvania 1928, Jefferson Medical College 1928), LL.D. (University of Aberdeen 1924 and Western Reserve 1928), D.P.H. (Camb.), F.R.S., F.R.S. (Can.), was a son of the manse, born at Cluny, near Dunkeld, Scotland, in 1876, a son of the Reverend Robert Macleod. He was educated at Aberdeen Grammar School, Marischal College, Aberdeen and Cambridge University.

After a short period of postgraduate study on the Continent and in London, like many another Scot, he migrated to the United States. At the early age of 27 years, he was appointed professor of physiology at Western Reserve University, Cleveland, Ohio.

Here he established for himself a reputation as a teacher of physiology and an investigator in the field of carbohydrate metabolism, which attracted the attention of the authorities in Toronto. In 1918 Professor Macleod was appointed to the chair of physiology at the University of Toronto, where he remained till 1927. He took a keen and deep interest in medical education and was instrumental in the establishment of the six-year course in medicine at the university here.

Soon, his laboratory attracted a group of young workers in physiology. It was due to Professor Macleod's established reputation as an authority in carbohydrate metabolism that Dr. Banting, now Sir Frederick, came to Toronto to consult him and to pursue his investigations on the pancreas with the assistance of C. H. Best, then a young assistant, who eventually succeeded Professor Macleod as professor of physiology at the University of Toronto. These investigations led to the brilliant and important discovery of insulin by Dr. Banting and Mr. Best.

With the aid of Dr. J. B. Collip the first stages of purification of insulin were undertaken and arrangements made for its commercial production. For the final purification, a large group of workers contributed, including Professor P. A. Shaffer, of Washington University, St. Louis, and Professor J. J. Abel, of the Johns Hopkins University, Baltimore.

In recognition of this very important discovery, Dr. Banting and Professor Macleod were awarded jointly the Nobel Prize, the former sharing the award with Dr. Best and the latter with Dr. Collip.

In 1927 Professor Macleod returned to his alma mater as Regius professor of physiology, an honor which he himself valued greatly. At the time of his death he was chairman of the department of research in the Rowatt Institute of the University of Aberdeen.

Many outstanding honors were accorded him from universities and scientific bodies in Canada, the United States and Great Britain, and he was the author of numerous books of physiology and biochemistry. Among such honors was the fellowship of the Royal Society, presidency of the American Physiological Society in 1922, the Royal Canadian Institute in 1925, fellow of the Royal Society of Canada, honorary fellow of the Academy of Medicine, Toronto, foreign associate fellow of the College of Physicians of Philadelphia, and corresponding member of the Medical Chirurgical Society of Bologne and of the K. Deutsche Akad. Natur-Forscher zu Halle. He was the winner of the Cameron Prize at the University of Edinburgh in 1923, and was a member of the American Physiological Society, the Society for Experimental Biology and Medicine, the Society of Biological Chemistry, the Association of American Physicians, the American Association for the Advancement of Science, the London Physiological Society and the Biochemical Society.

He is survived by his widow, Mary McWalters. He had no children.

VELYIEN E. HENDERSON
UNIVERSITY OF TORONTO

RECENT DEATHS

ERNEST B. SKINNER, professor emeritus of mathematics, for forty-two years a member of the faculty of the University of Wisconsin, died on April 3. He was seventy-one years old.

PROFESSOR THOMAS CRAMER HOPKINS, until his retirement in 1931 head of the department of geology at Syracuse University for thirty-one years, died on April 3 at seventy-three years of age.

Nature reports the death of Dr. B. M. Wilson, professor of mathematics in University College, Dundee, formerly lecturer in pure mathematics in the University of Liverpool, on March 18 at the age of thirty-eight years, and of Major-General Sir Richard M. Ruck, of the Royal Engineers, known for his scientific work in submarine mining and chairman of the council of the Royal Aeronautical Society from 1912 to 1919, on March 18, aged eighty-three years.

SCIENTIFIC EVENTS

CENTENARY OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN[1]

THE Geological Survey of Great Britain is the oldest national geological survey in the world, having now been in active existence for a hundred years. It owes its inception to the private enterprise of the late Sir Henry Thomas De la Beche, who became its first director. Geological material was quickly accumulated and De la Beche was compelled to ask for museum accommodation. This was provided in a house in Craig's Court, Charing Cross, where it was opened to the public in 1841, as the Museum of Economic Geology. In 1851, the museum was transferred to Jermyn Street, where it has continued until recently. For many years past, however, the space available has been inadequate, and it has been impossible to display to full advantage the very extensive collections of rocks, fossils and minerals in the possession of the survey and museum. In 1912, the Bell Committee recommended the transfer of the museum and survey to a site in South Kensington next to the Natural History Museum, but no action was taken until the Museums Commission met in 1927. The government then agreed to the transfer, and the new building was completed by H.M. Office of Works in 1933. Occupation by the Geological Survey was, however, delayed by its utilization as the meeting place of the World Economic Conference, 1933.

It is now announced that the new Museum of Practical Geology will be formally opened next July. Advantage has been taken of this to arrange a joint celebration of the centenary of the Geological Survey and the opening of the new museum. In the new museum at South Kensington ample accommodation has been provided to display the exhibits in a building specially designed to meet modern museum requirements. New material has been acquired from many sources and the extent and scope of the exhibits has been enlarged. For the past three or four years, geologists of the survey and museum have been mainly engaged in rearranging and bringing up to date the collections, their normal field work being subordinated to the needs of the museum. At the back of the museum new offices have been provided for the Geological Survey, together with modern laboratories for the prosecution of petrological and mineralogical research. Enlarged accommodation has been provided for the library and collection of maps which, as in the past, will be available for consultation by the public. The museum is to be opened by the Duke of York on July 3. On July 4 there will be a morning reception of delegates to the centenary, followed by an address by the director of the survey on the history and functions of the Geological Survey of Great Britain. On the evening of July 4 there will be an evening reception by H.M. Government. Excursions to several of the classic areas of British geology follow immediately after the meetings. It is expected that a large and representative gathering of geologists from all parts of the world will be present for the celebration.

[1] From *Nature*.

INVESTIGATION OF WEATHER CONDITIONS IN THE STRATOSPHERE

PLANS for continuing the study of weather conditions in the stratosphere by means of sounding balloons equipped with sensitive recording instruments have been announced by the Division of Meteorology of the Massachusetts Institute of Technology. The study will begin soon at Lambert Field Airport in St. Louis, Mo., where the institute already has carried out two successful investigations of this type.

Chris Harmantas, who will be in charge of field operations, has left for St. Louis. He took with him 36 sounding balloons. While the time of their release will depend on weather conditions, it is hoped that they may be sent up within a short time.

Each balloon will carry a specially designed instrument, weighing only a few ounces, for automatically recording temperature, humidity and atmospheric pressure. The balloons will be only partially inflated in order that they may expand upon reaching the rarefied air of the stratosphere. Upon reaching their limit of expansion they will burst, allowing the instruments, which are encased in shock-absorbent frames, to fall to the earth. Each will carry an identification label offering a reward for its safe return to Professor C.-G. A. Rossby, director of the division.

Following the balloon flight last November, 29 of the 35 bags released were found and returned by residents within a radius of 100 miles around St. Louis. In view of the more favorable season, institute meteorologists hope to recover an even greater number in the forthcoming tests.

While the data obtained in the previous investigations are still being studied, several interesting observations have been made concerning the nature of the stratosphere, that layer of the atmosphere where temperature no longer decreases with height. At the base of the stratosphere over St. Louis last November, extraordinary fluctuations of temperature, ranging from 36 degrees below zero Fahrenheit to 78 degrees below, were recorded. The base of the stratosphere itself was found to vary greatly in height, shifting suddenly from 25,000 to 40,000 feet above the earth.

RESEARCH FELLOWS AT YALE UNIVERSITY

EIGHTY-FIVE research projects are being carried on at Yale University this year by a similar number of research fellows who already have the Ph.D. degree. Many of them are recipients of fellowship awards by the Yale Graduate School or by outside organizations; others are members of the faculties of colleges and universities to whom the facilities of its faculties, its libraries and laboratories have been made available without charge. Eleven foreign countries and eighteen foreign and sixty-two American institutions of higher learning are represented among this group of scholars.

Among those carrying on research in the sciences are:

Dr. Charles D. Bock, of South Bend, Indiana, is making a study of the fundamental phenomena involved in the interaction between ions and gases. Dr. John S. Burlew, of New Haven, Conn., is beginning a coordinated series of researches on the nature of the liquid state. Dr. Tze Tuan Chen, of Foochow, China, is extending his study of the mechanism of heredity among some unicellular organisms.

Dr. Marion E. Howard, of New York City, is conducting research on vitamins. Dr. Fred E. Ingerson, of Barstow, Texas, has undertaken a study of petrofabrics.

Dr. Orvel H. Mowrer, of New Haven, Conn., is studying specific reflexes elicited in certain sense organs in the non-acoustic portion of the otic labyrinth. Dr. Sidney S. Newhall, of New Haven, in cooperation with Dr. Deane B. Judd, of the Colorimetry Section of the Bureau of Standards, is making a scientific study of the nature and course of chromatic adaptation.

Dr. Ernest C. Pollard, of Lincolnshire, England, continues his investigation of the light atomic nuclei. Dr. William C. Randels, of Alma, Michigan, is studying mathematical problems in connection with the Fourier series under the direction of Professor Hille.

Dr. Helen G. Richter, of New Haven, is attempting a completion of data obtained on sympathetic vaso-motor pathways and their central connection. Dr. Julien A. Ripley, Jr., of Hamden, Conn., is continuing research on the philosophy of science.

Dr. Harold H. Williams, of Howard, Pa., is extending his research to the possible rôle of cholesterol in fat mobilization. Dr. Max Zorn, of Hamburg, Germany, is attempting to develop an elementary method in studying higher laws of reciprocity in the field of mathematics.

Two Bishop Museum fellows are conducting research in the islands of the Pacific: Dr. Horace B. Baker, of Philadelphia, Pa., is making an anatomical and systematic study of the Pacific Zonitidae at the Bishop Museum under the direction of Dr. C. Montague Cook, Jr. Dr. Ernest Beaglehole, of Wellington, New Zealand, is making a general ethnographic study at Puca Puca in the Tuamotu group of islands. In the field of chemistry, Dr. Robert O. Bengis, of New Haven, is holder of the Standard Brands, Inc., fellowship; Dr. Werner Bergmann, of New Haven, and Dr. Mearl A. Kise, of Allentown, Pa., hold Textile Foundation, Inc., fellowships; Dr. John A. Crowder, of New Haven, and Dr. Frank Stodola, of Hopkins, Minnesota, are working under the auspices of the National Tuberculosis Association; Dr. Kathleen O. P. Jackson, of Devon, England, is the holder of a Henry Fund fellowship, and Maurice L. Moore, of Crestview, Fla., is A. Homer Smith fellow.

The following held fellowships from the General Education Board: Dr. Adrian Buyse, of Rochester, New York, in zoology; Dr. Harry G. Day, of Chariton, Iowa, in physiology; Dr. William W. Greulich, of Los Altos, California, in anatomy; Dr. Sander E. Lachman, of Baltimore, Maryland, in clinical medicine, and Dr. John B. Wolfe, of Dryden, Virginia, in psychology. The National Research Council is represented by the following: Dr. Harold E. Clark, of Montague, Massachusetts, in botany and physiological chemistry; Dr. Jack M. Curtis, of St. Louis, Missouri, in anatomy; Dr. William U. Gardner, of Columbia, Missouri, in anatomy, and Dr. Louis S. Goodman, of Portland, Oregon, in pharmacology and toxicology. Recipients of Rockefeller Foundation fellowships are: Dr. George Seth, of Edinburgh, Scotland, in psychology, and Dr. Donal Sheehan, of Manchester, England, in physiology. Holders of Alexander Brown Coxe Memorial fellowships are: Dr. Jane L. Chidsey, of Easton, Pa., in physiology; Dr. William G. Gordon, of New York City, in physiological chemistry; Dr. Arild E. Hansen, of Minneapolis, Minnesota, in clinical medicine and pathology, and Dr. James M. Orten, of Denver, Colorado, in physiological chemistry. The Davis and Geck fellows are: Dr. Irving Friedman, of New York City, and Dr. Orvan W. Hess, of Margaretville, New York, both in surgery.

SYMPOSIUM IN THEORETICAL PHYSICS AT THE UNIVERSITY OF MICHIGAN

THE Symposium in Theoretical Physics at the University of Michigan will be held between the dates of June 24 and August 16. Professor Enrico Fermi, of the Royal University of Rome, will lecture throughout the session on "Selected Subjects in Quantum Mechanics." He will place special emphasis upon applications to nuclear physics and other recent developments. Professor Felix Bloch, of Stanford University, will present the "Quantum Theory of the Metallic State." His lectures will extend from July 1 to July 26 and will treat theoretically the various properties of metals. "The Theory of Atomic Spectra" including interpretations of line spectra, the many electron problems, hyperfine structure and nuclear spin, will be offered by Professor S. A. Goudsmit, University of Michigan. He will lecture throughout the session. Professor G. E. Uhlenbeck, of the University of Michigan, will lecture for the first half of the session on "Advanced Quantum Mechanics." The Dirac theory of the electron and positron will receive special attention.

In addition to the formal lecture courses, there will be a series of informal seminars throughout the ses-

sion under the personal direction of Professors Fermi, Bloch, Goudsmit and Uhlenbeck, at which recent developments of theoretical physics will be discussed. Holders of the doctor's degrees may attend all sessions as guests of the university.

In addition to the symposium proper, the department of physics offers a very complete schedule of graduate courses, with special facilities for research in the following fields: spectroscopy, throughout the entire spectrum from x-rays to the far infrared, chemical analysis by spectroscopic methods, sound, vacuum tube phenomena and high-frequency measurements. For additional particulars and announcements address the director of the Physical Laboratories, University of Michigan.

THE HARVARD SUMMER GRADUATE SCHOOL OF ASTRONOMY

THE summer of 1935 marks the inauguration of the Harvard Summer School of Astronomy which is to meet concurrently with the Harvard Summer School of Arts and Sciences. While, in the past, the department of astronomy has offered instruction in elementary astronomy during the summer and has made available facilities for research under the guidance of members of the staff of the observatory, this reorganization of summer instruction provides particularly an extension of the opportunities for advanced instruction, for the pursuit of research, and for profit from informal conferences and colloquia. At the same time the program of elementary instruction has been extended.

The staff of the department is enlarged during the summer session by a number of visiting astronomers who offer seminars in their special fields, contribute to the informal discussions, and assist in the guidance of those engaged in research.

The equipment available to graduate students at the observatory and at the astronomical laboratory includes:

1. The collection of some 400,000 photographic plates accumulated by means of the many photographic telescopes at the three stations of the observatory—at Cambridge, at Oak Ridge and at the southern station, formerly at Arequipa, Peru, but, since 1927, at Bloemfontein, South Africa.

2. The library containing a complete collection of current journals, publications of observatories and astronomical treatises.

3. The telescopic equipment at Cambridge and Oak Ridge, comprising five visual telescopes with apertures ranging from 15 inches to 6 inches, fourteen photographic refractors with apertures ranging from 16 inches to 1¼ inches, the 24-inch reflector and the 61-inch Wyeth reflector equipped for photoelectric and spectrographic work. The Oak Ridge Station is located in the town of Harvard, 25 miles west of Cambridge, is easily accessible and possesses dormitory facilities for those engaged in observational work and a cottage for recreational purposes.

4. Accessory equipment comprising a Schilt photometer, a Moll microphotometer, a new microdensitometer, measuring machines, star-counting machines and telescopic photometers for use in visual variable-star photometry.

5. A completely equipped machine shop located at the Astronomical Laboratory, available for the use of those engaged in graduate study who desire to experiment in the construction of special apparatus.

Members of the visiting staff include:

Dr. Ira S. Bowen, of the California Institute of Technology, known for his solution of the riddle of nebulium and for his other applications of atomic theory to the prediction and verification of unidentified lines in astrophysical sources.

Dr. Freeman D. Miller, of Denison University, engaged in studies of the structure of the Milky Way on the basis of star counts.

Dr. Peter M. Millman, of the University of Toronto, an authority on meteors and meteor spectra.

Dr. Antonie Pannekoek, of the Astronomical Institute at Amsterdam, known for his studies of the galactic system and in recent years interested in problems dealing with the production of spectral lines in stellar atmospheres.

Dr. Otto Struve, director of the Yerkes Observatory of the University of Chicago, known for his interest in the spectroscopic problems that the stars present and for his contributions to the study of interstellar matter.

Dr. Olin C. Wilson, of the Mount Wilson Observatory, whose work concerns the interpretation of stellar spectra and related astrophysical problems.

PRESIDENT ANGELL AND THE SOCIETY OF EXPERIMENTAL PSYCHOLOGISTS

TRIBUTE was paid to President James R. Angell, of Yale University, as a pioneer and leader in the development of the science of psychology at a dinner given in his honor on April 5 in New Haven by a group of leading psychologists. Professor Walter R. Miles, president of the Society of Experimental Psychologists, in session at Yale, introduced President Angell and called attention to the fact that thirty years ago he became full professor of psychology at the University of Chicago and first head of the department in which many distinguished psychologists have been trained. A correspondent writes:

"For fifteen years President Angell was intensively engaged in experimentation and his scientific contributions are many. He also wrote a text-book on psychology which was the first after that of William James to come into wide-spread use in schools and colleges and to become an important factor in the dissemination of knowledge of psychology. He was for many years editor of *The Psychological Monographs*,

the series of research publications, and he was the fifteenth president of the American Psychological Association.

"With Professor John Dewey, who was at Chicago at the same time, President Angell was largely responsible for shifting the emphasis from the study of the structure and elements of mental life to the process of adaptation of the individual to the environment. President Angell has also long been distinguished as a collaborator and as a lecturer in the field of psychology. In his talk at the dinner President Angell reviewed the tremendous development of psychology in recent decades. He said that the science of psychology and human relations has never been more important from the point of view of the needs of the world than it now is and he urged concentration on the study of motivation as the present greatest concern of civilization."

The Society of Experimental Psychologists was organized as a national professional society of restricted membership at Yale in 1928. It has a membership of forty of whom half were at the meeting, which was devoted to informal discussions of psychological problems. Professor Walter Hunter, of Clark University, a former student of President Angell, was elected president for the coming year. The eighth annual meeting, next year, will be held at Clark University.

SCIENTIFIC NOTES AND NEWS

Professor Frank Schlesinger, director of the Yale University Observatory, will preside over the biennial congress of the International Astronomical Union which will be held at Paris from July 9 to 17.

Honorary doctorates of laws will be conferred in June by the University of Edinburgh on Dr. M. M. Ogilvie Gordon, geologist; on Professor J. G. Kerr, Regius professor of zoology at the University of Glasgow; on Professor J. Laird, Regius professor of moral philosophy at the University of Aberdeen, and on Dr. Alfred N. Richards, professor of pharmacology at the University of Pennsylvania.

Sir James Hopwood Jeans has been nominated for election to a newly established chair of astronomy in the Royal Institution, London.

Dr. Clark Wissler, curator-in-chief of the department of anthropology at the American Museum of Natural History, was elected dean of the scientific staff at a meeting of the council held on April 1. Dr. H. E. Anthony, curator of the department of mammalogy, was elected secretary of the council.

The Distinguished Service Gold Medal of the National Foundation of Optometry has been awarded to Dr. Theodore A. Brombach, lecturer in optometry at the University of California, for his work on color field studies. The medal was presented by Dr. Karl T. Compton, president of the Massachusetts Institute of Technology.

In recognition of "distinctive service for twenty-five years" as dean of the School of Pharmacy of Purdue University, Dr. C. B. Jordan was recently presented with an illuminated parchment by members of the faculty of the school and with a gold watch by J. K. Lilly, Sr., a member of the board of trustees of the university. The presentation took place at a banquet given at the close of the fifth annual Druggists' Business Conference. Tributes were paid to Dr. Jordan in a series of three-minute addresses made by Dr. Robert P. Fischelis, president of the American Pharmaceutical Association, representing the nation; F. V. McCullough, Indianapolis, secretary of the Indiana Pharmaceutical Association, and E. A. O'Harrow, Bloomington, president of the Indiana Board of Pharmacy, representing the state, and Dr. E. C. Elliott, president of the university.

The American Chemical Society announces that the first Eli Lilly and Company award in biological chemistry, carrying $1,000 in cash and a bronze medal, will go to Dr. Willard M. Allen, of the University of Rochester. Dr. Allen, who is only thirty years old, receives the prize for the preparation and chemical purification of the sex hormone progestin. The presentation will be made at the eighty-ninth meeting of the society in New York during the week of April 22, when Dr. Allen will read a paper on his research work. Professor Edward Bartow, of the State University of Iowa, president-elect of the society, was chairman of the committee of award. Other members were: H. T. Clarke, Columbia University; L. J. Henderson, Harvard University; W. R. Bloor, University of Rochester; H. B. Vickery, Connecticut Agricultural Experiment Station; P. A. Shaffer, Washington University, and D. D. Van Slyke, the Rockefeller Institute.

The D'Arsonval Prize has been awarded by the French Society of Electrotherapy and Radiology to Dr. Etienne Hubert Henrard, Belgian physician, for a thesis on "Short Hertzian Waves and Their Medical Applications."

A joint meeting of the Louisiana Academy of Sciences with the Louisiana-Mississippi branch of the National Council of Teachers of Mathematics and of the section of the Mathematical Association of Amer-

ica was held on March 29. Officers of the academy elected to serve for two years are: *President,* Dr. E. H. Behre, Louisiana State University; *Vice-president,* Dr. H. L. Kearney, New Orleans; *Secretary-treasurer,* Professor A. L. Ducournau, Louisiana State Normal College, Natchitoches; *Permanent Secretary,* Professor Alvin Good, Louisiana State Normal College; *Editor,* Dr. W. R. Hammond, Louisiana State Normal College; *Chairmen of the Divisions,* physical sciences, Dr. A. R. Choppin; biological sciences, Professor G. B. Claycomb; social sciences, Dean Charles W. Pipkin; geology-geography, Professor H. J. Chatterton; applied sciences, C. R. McKnight.

J. F. NORMAN GREEN was elected president of the Geological Society of London at the recent annual meeting and Professor P. G. H. Boswell, Professor W. S. Boulton, Professor H. L. Hawkins and Sir Thomas Holland were elected vice-presidents.

RECIPIENTS of grants from the Committee on Scientific Research of the American Medical Association include Dr. Frank R. Menne, professor of pathology at the University of Oregon Medical School, for a study of cholesteremia in rabbits; Dr. Lloyd H. Ziegler and Dr. Arthur Knudson, of the Albany Medical College, Albany, N. Y., for completion of their work on activity after recovery from rickets, and F. A. and E. L. Gibbs toward the completion of a study of the regions in the cat's brain which have an especially low convulsion threshold. The work is to be done in the department of physiology of the Harvard Medical School.

DR. JAMES CHADWICK, fellow of Caius College, Cambridge, and assistant director of research in the Cavendish Laboratory, has been appointed to the Lyon Jones chair of physics in the University of Liverpool as from October 1 next, in succession to Professor L. R. Wilberforce, who retires at the end of the present session.

PROFESSOR WILLARD ALFRED KNAPP has been named assistant dean of the School of Engineering of Purdue University. For some years he has been in charge of the department of engineering extension.

A LIFE SCIENCE GROUP, embodying the three departments heretofore designated under the name of the Department of Biological Sciences, was established on April 1 by the University of California at Los Angeles. Dr. Loye Holmes Miller, heretofore chairman of the department of biological sciences, has been named chairman of the new group. The three new departments will include as chairmen: bacteriology, Dr. Theodore D. Beckwith; botany, Dr. O. L. Sponsler, and zoology, Dr. B. M. Allen.

J. ERIC THOMPSON, assistant curator of Central and South American archeology at the Field Museum, Chicago, has resigned to accept a position on the staff of the Carnegie Institution of Washington, D. C.

PROFESSOR W. H. HORNING, of the department of forestry at the Iowa State College, has been appointed temporary assistant to John P. Coffman, chief forester of the National Forest Service. During his absence he will be replaced by G. B. Hortman.

PROFESSOR E. O. LAWRENCE, of the department of physics, of the University of California, has been appointed a member of the consulting board of the Institute of Cancer Research of Columbia University.

AT a meeting of the council of the University of Sheffield held on March 8, Professor J. B. Leathes, F.R.S., was reappointed representative of the university on the General Medical Council for a further term of three years.

THE following appointments recently made by the British Secretary of State for the Colonies are noted in *Nature:* H. Atkinson, to be deputy government analyst, Ceylon; J. R. E. Hindson, inspector of plants and produce, to be assistant superintendent of agriculture, Gold Coast; A. H. Malpas, assistant marine biologist, to be director, Colombo Museum, and marine biologist, Ceylon; D. B. Sabiston, deputy superintending produce inspector, to be superintendent of agriculture, Nigeria.

DR. EDWARD H. GRAHAM, assistant curator of botany at the Carnegie Museum, Pittsburgh, Pa., and Mrs. Graham will leave about April 15 for their third season of botanical exploration in the Uinta Basin of northeastern Utah. They plan to make collections in the Book Cliff Mountains, which form the southern rim of the basin and in the adjoining arid areas.

THE William Potter Memorial Lecture was delivered by Dr. C.-E. A. Winslow, professor of public health in the Yale School of Medicine, on March 29. His subject was "A Physician of Two Centuries Ago: Richard Mead and his Contributions to Epidemiology."

GENERAL FREDERICK F. RUSSELL gave an Eastman Memorial lecture at the University of Rochester School of Medicine and Dentistry on March 21 on "The Continuing Need for Research in the Field of Public Health." Professor Dallas B. Phemister gave on April 5 the last lecture in the series on "The Growth and Repair of Bone."

THE seventh lecture of the current series of the Harvey Society will be delivered by Dr. Francis G. Blake, Sterling professor of medicine at Yale University School of Medicine, on April 18 at the New York Academy of Medicine. His subject will be "Pneumothorax in the Treatment of Pneumonia."

DR. ROBERT A. MILLIKAN made a public address at Southwestern College, Winfield, Kansas, on April 8, entitled "In the Coming Century."

DR. JEAN PICCARD and Mrs. Jeanette Piccard lectured on April 11 before the Lancaster, Pa., Branch of the American Association for the Advancement of Science. The lecture was entitled "A Flight to the Stratosphere."

DR. LOUISE PEARCE, fellow of the Rockefeller Institute for Medical Research, addressed the Western Reserve University Chapter of the Society of the Sigma Xi on April 8 on "Epidemiological Aspects of Vaccinia."

DR. THORNE M. CARPENTER, of the Nutrition Laboratory of the Carnegie Institution of Washington, lectured in Worcester, Mass., on March 12, at a joint meeting of the Worcester Polytechnic Institute Chapter of the Society of the Sigma Xi and the Worcester Chemists Club. The subject of his lecture was "Investigations of the Carnegie Nutrition Laboratory on Basal Metabolism."

DR. R. G. HOSKINS, director of research for the Memorial Foundation for Neuro-Endocrine Research at the Harvard Medical School, and Dr. J. M. Looney, director of laboratories for the same foundation, at the Worcester State Hospital, have been engaged in giving a series of lectures entitled "Recent Advances of Endocrinology" to the Somerset County Medical Society of New Jersey under the auspices of the New Jersey State Medical Society and the Rutgers University Extension Service. Dr. Hoskins spoke on February 15 at Skillman, New Jersey, and on March 1 at Morristown. Dr. Looney spoke at Marlboro, N. J., on February 22, at Trenton on March 8 and March 22, and at Skillman on March 15.

THE fifth annual meeting of the Field Conference of Pennsylvania Geologists will have its headquarters at the Academy of Natural Sciences in Philadelphia, May 31 to June 2. Registration and museum tours will take place from 9 A. M. to 12 M. on Friday, May 31, and at 2 P. M. the first of the trips will leave Philadelphia to observe the physiography of the Piedmont upland and the adjacent Coastal Plain terraces around Philadelphia. An alternative trip to localities of mineralogic and petrologic interest to the north of Philadelphia will also be conducted on that afternoon. On Saturday, June 1, the conference will leave the academy at 8 A. M. on a general trip through the crystalline and intrusive rocks of the Piedmont Belt in the Philadelphia area. On Sunday, June 2, they will leave at the same time to examine the lower Paleozoic formations and their relations to the pre-Cambrian rocks in the area west of Philadelphia. This trip will go as far west as Quarryville, which is the type area of the Martic overthrust. On Monday, June 3, a post-conference optional excursion to the Coastal Plain of New Jersey will be conducted.

THE Special Libraries Association will hold its twenty-seventh annual convention in Boston from June 11 to 14 with headquarters at Hotel Statler. The organization has now a membership of over 1,600 trained librarians who manage the libraries of industrial concerns, research laboratories, banks, business offices, newspapers, museums, law, medical, scientific and other societies, as well as the specialized departments in large public, college and university libraries —in fact, any library devoted to one special field. The importance of trained library service to such special groups is now widely recognized and the Special Libraries Association devotes itself actively to the improvement of the methods and quality of such service. The program of the coming meeting includes visits to the special libraries of Harvard University, Massachusetts Institute of Technology and other special libraries in the Boston area, besides three general sessions and a large number of group and section meetings. The science-technology group, which includes librarians of several science libraries and of science departments of various colleges and universities, with a membership of over 200 will hold three meetings. There will also be opportunity for visits to historic shrines in and near Boston.

ACCORDING to the London *Times*, Dr. T. E. Schumann, Johannesburg, chief Union meteorologist, will introduce at the Imperial Meteorological Conference in London in August a proposal in favor of the establishment of a meteorological station at Tristan da Cunha. With the support of the conference the Union Government probably will sanction the scheme and proceed with the proposal, which includes the provision of a wireless station for the dissemination of meteorological information. The estimated cost of establishing such a station would be £5,000. The experiment would be given one year's trial, but it is believed that it would mean such an improvement on the existing sources of meteorological data at the disposal of the Union that permanency would be justified.

DISCUSSION

PEARY'S DISCOVERY OF THE NORTH POLE

THE REV. J. GORDON HAYES has now since 1924 been writing books and pamphlets with the one object of discrediting Admiral Peary, the discoverer of the North Pole. In the length of such occupation he has been exceeded by another British writer, one W.

Henry Leewin, who writes of his announced forthcoming book, "A Remarkable History of the Author's 25 Years' Effort to Establish the Truth of 'Peary' and the North Pole." So far as we are aware, Hayes printed his first attack upon Peary in the July issue of the Manchester Geographical Society in 1924. This was followed in 1929 by the book, "Robert Edwin Peary, A Record of his Explorations 1886–09," and now by "The Conquest of the North Pole" (Macmillan, 1935, 317 pp., ill.).

This latest book, like its predecessors, is a rare combination of misstatement of facts, of innuendoes, impugnment of motive, omission of vitally important facts, and citations by page of Peary's works, which when examined are found to be quite other than they are stated to be—but all treated with scholarly mannerisms and with an appearance of meticulous documentation which will probably deceive those without a background of knowledge of the subject.

One's first impulse is to ascribe all this to ignorance, but statements which can not possibly be explained away by carelessness make it necessary to conclude that Mr. Hayes's intent has been deliberately to mislead. An instance is the statement (p. 47) that Peary placed Dr. Cook's "Bradley Land" upon his maps—preposterous and untrue.

The subject of the book has been curiously chosen, since its object is to show that the North Pole has not been reached, except perhaps by Dr. Cook, and through the air by Byrd in airplane, and by Amundsen in airship (these two explorers together are covered in the book by three pages of text).

The motif of the volume is in Chapter II ("The Sledge-Race for the North Pole"), ten pages of text intended to cover Peary's twenty-three years of Arctic effort and the faked trip of the notorious Dr. Cook, who is treated seriously and enthusiastically by Hayes, who devotes half the chapter to praise of him.

The entire geographical world now knows of the complete exposure in 1909–1910 of the Mt. McKinley and North Pole frauds of Dr. Cook, and his confession of his "delusion" published in January of 1910; but there are perhaps some not familiar with Cook's later career and particularly with his stupendous oil swindle, which involved tens of millions of dollars. For this in 1923 he was tried and convicted in United States District Court and sentenced to imprisonment in a Federal penitentiary for the term of fourteen years and nine months.

With this in mind there is humor of a sort in Hayes's approval of Cook's "My Attainment of the Pole" in these words: "This book as a whole bears the stamp of reality; . . . his word had never been doubted. . . . Bradley Land, the most important discovery claimed by Cook . . . never appears to have been doubted (no one of reputation believes in it, nor does it appear upon any reputable map. W. H. H.), and Peary placed it upon his maps" (this is untrue. W. H. H.).

Again Hayes states (p. 48), "All that Peary submitted to the Royal Geographical Society were copies of some of his alleged observations." This slurring statement is obviously intended to convey the impression that Peary nowhere submitted his original observations to expert examination. Hayes's intellectual honesty thus suffers, since he knows that these original observations were submitted both to the committee of the National Geographic Society in Washington and to the distinguished experts, Mitchell and Duval, who reported to the Congressional committee, and it was upon their unqualified approval that Congress awarded Peary a vote of thanks and recommended his elevation in rank from Commander to full Rear Admiral in the United States Navy.

The Royal Geographical Society certainly did not expect that Peary's precious *original* records would be sent across the sea, and, apparently quite satisfied with the copies, they awarded Peary a *Special* Gold Medal which in the 105 years of the society's history has been awarded but four times (to Stanley, Nansen, Peary and Shackleton). The president of the society when conferring this unusual award made a remarkable citation:

> It is on these grounds (the examination and approval of Peary's observations by experts) that I stand here to-night as the representative of the Royal Geographical Society, and, armed with the full authority of its Council, to welcome you, Commander Peary, as the *first and only* (italics not in the original) human being who has ever led a party of his fellow-creatures to a pole of the earth.

In discussing Peary's marches when returning from the Pole, Hayes says, "he said he did not ride (*op. cit.*, 193–4, 250–1, also 199)." Not one of these citations supplies any warrant for the statement made by Hayes, and we know from published statements by both Bartlett and Henson that Peary rode much of the way, as is in fact the custom generally when exceptionally long marches are made by dog-sled. The long daily marches of Peary on his return from the Pole, which have been attacked by hostile critics, had before been many times exceeded on sea-ice not only by Peary but by other explorers, as is known to all who have taken the trouble to examine the facts.

Since Hayes's treatment of the conquest of the Pole is limited to some fifteen pages in all, the remaining 300 pages of the book are given over to a summary

of Arctic and, almost entirely, British expeditions, none of which had anything whatever to do with attempts upon the Pole. The number of books of this character is legion, most of them written, like this one, by persons without experience in the polar regions. Some of them are certainly superior to that by Hayes, though some may possibly be worse. The strong British and anti-American bias of the author, combined with his apparent lack of intellectual honesty or of a sense of values, makes him peculiarly unfitted for a task which calls loudly for sanity of judgment and for some measure of an international view-point.

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A STUDY OF THE RELATION OF THE RELATIVE SIZE OF THE TWO HANDS TO SPEECH

FROM a preliminary study of college students conducted last year at the State University of Iowa evidence was obtained which points to the conclusion that there occurs a difference in the volumetric size of the two hands. The hands of thirty-four normal speakers, twenty-four of whom were right-handed, were measured and it was found that 87.5 per cent. had larger right hands, while only 8 per cent. had larger left hands. Eight left-handed subjects were studied, five of whom were found to have larger left hands, with only one having a larger right.

Since there is assumed to be a lack of dominant lead in the stuttering person, if we further assume that the difference in the size of the two hands is due to development through use it might be expected that findings on normal speakers and stutterers would not agree. A similar study was therefore made of thirty-three stutterers who had shifted handedness not to exceed a year previous to measurement, but findings were similar to those for normal speakers. This group included twenty-seven cases who had used the right hand up to time of shift; 85.2 per cent. of these subjects had larger right hands, while only 7.4 per cent. had larger left hands.

By slightly altering the present technique and measuring a large number of cases it will be possible to determine with greater precision the quantity of difference for each person and then compare averages for each group. Further, it is the author's purpose to determine the cause of this condition and whether it is pre- or post-natal. If it is found to be the latter, attempt will be made—by studying children of various ages—to determine at what age these size differences occur.

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EDEMA AND GENERAL ATROPHY IN STENOSTOMUM OESOPHAGIUM

DISTENDED, abnormally large individuals have been found in certain cultures of *Stenostomum oesophagium*. An examination of these abnormal animals has led to an investigation of this condition, which has been termed edema. A study of the causes of edema in *Stenostomum oesophagium* is now being made.

The first step in this edema is the destruction of the main stem of the protonephridium. Morphological changes which follow the destruction of the main stem are the accumulation of fluid in the pseudocoel, the distention of the epidermis, the branching of the enteron, the migration of cells from both the epidermis and the enteron, the destruction of many of the elements of the parenchyma, the foreshortening of the capillary portion of the protonephridium and the addition to the number of the flame cells.

Certain factors, such as parasitism, light, temperature and hydrogen-ion concentration, appear to have little or no effect in producing the atrophy of the main stem of the protonephridium, the quantity of the food ingested seems to be the most important of the factors studied to date. Of 325 individuals of a clone, the members of which were fed abundantly, 284 died of edema; of 675 individuals of a clone, the members of which were fed only once a day, 46 died of edema. A study is being made of other factors that may determine the atrophy of the main stem of the protonephridium and the consequent edematous condition.

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BANG'S ABORTION DISEASE OF CATTLE

THE author, working at the Kansas Agricultural Experiment Station, has developed a strain of *Brucella abortus var. bovis* which does not produce agglutinins following massive doses, although a thermal response is noted in each instance. Bang negative cattle remain non-reactors indefinitely to the standard agglutination tests (rapid and tube), following injection of this vaccine.

A live germ vaccine of this strain is readily absorbed without abscessation in all the experimental animals. No enlargement of the spleen is noted in guinea-pigs and rabbits.

Experiments are being planned to determine the protective and immunizing value of this product in cattle under simulated field conditions.

CHAS. H. KITSELMAN

SCIENTIFIC APPARATUS AND LABORATORY METHODS

APPARATUS FOR DUSTING SULFUR ON PLANTS IN CONTROLLED AMOUNTS

WHILE making comparative studies on different brands of sulfur, it became necessary to secure dusting apparatus that would deliver quantitatively small amounts of sulfur to the under surface of leaves. Since many brands of sulfur stick tenaciously to dusting equipment and at the same time produce little or no fog, the common methods of applying dust under laboratory conditions were not satisfactory. The apparatus herein described has been satisfactory for the purpose intended and may be of value to other workers.

A dust gun was made from a small glass cylinder 80 mm by 15 mm (A) fitted with two corks. Into one cork was inserted a metal tube with a 1 mm opening which admitted compressed air. The air was under 20 pounds pressure and controlled by a valve (B) obtained from a cheap spray gun. From the other cork led a glass tube fire polished to a 1 mm opening. This glass tube connected by means of a rubber tube (C) with the dusting chamber. The dusting chamber consisted of a large wooden box enclosing a phonograph turn table (D) which was used to transmit power to a cookie can (E) held at a 45° angle with the open end down. Plants grown in flower pots were inserted into the cookie can and revolved as the phonograph turned. The sulfur came into the dusting chamber, hit a glass plate (F) and diffused evenly over the revolving plant. When filling the glass dust gun, a small rod was held in the center of the gun and was removed later. This left a small cylinder of dust, which was gradually removed in its entirety by the force of air passing through the center of the sulfur cylinder on its way to the dusting chamber.

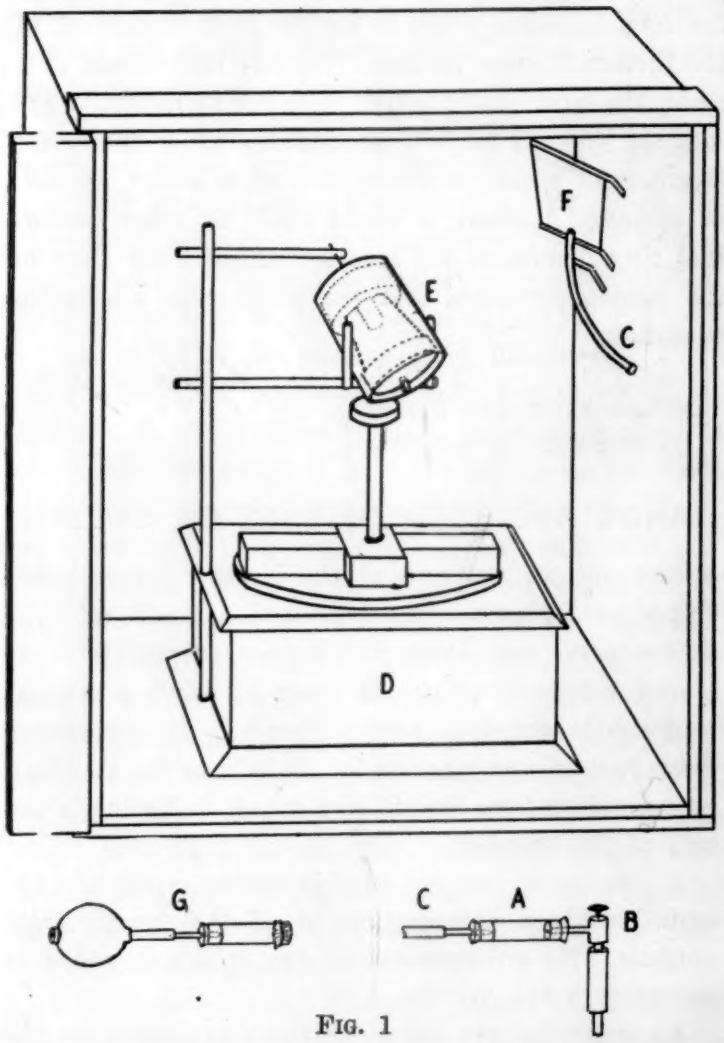

FIG. 1

The dust gun may be adapted into a very useful small hand duster (G) by attaching a rubber bulb to the glass tube and by placing a cheese cloth over the other end. A rod is held in the center of the glass cylinder while filling in the same manner as described above. The cheese-cloth serves as a screen to prevent coarse particles from leaving the duster and at the same time diffuses any large puffs of dust that might be emitted.

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A NEW STAINING METHOD FOR STRUCTURES OF THE SPINAL CORD

DISADVANTAGES in staining of cytons and Nissl bodies (chromophilic bodies) of the spinal cord may be overcome by employing dyes that contain greater amounts of methylene violet. Polychromed methylene blue does not contain sufficient methylene violet to prevent fading, especially in combination with acidic contrast dyes, such as eosin. The Nissl methylene blue stain is polychromed with castile soap and allowed to age for some time before use, but fading occurs in a short time if an acidic counterstain is used. Cytons become destained within one week.

By employing the Giemsa stain and differentiating in 95 per cent. and absolute alcohol, a brilliant effect was obtained. However, fading within a few days was noticed when an acidic counterstain was employed.

In order to obtain the advantages of selectivity and permanence the following mixture of dyes and timing was arrived at:

Five parts of a solution of Wright's blood stain in 95 per cent. denatured ethyl alcohol to one part of a standard solution of Giemsa was prepared. The spinal cord of a steer, fixed in 10 per cent. acid-free formaldehyde, was sectioned at 10 mu. Slides were passed through xylol and graded alcohols to distilled water and flooded with the above mixture of dyes for two minutes. The dye was then diluted with an equal amount of distilled water for two minutes and the slides then immersed in fresh distilled water for one minute. The sections were passed immediately into 80 per cent. alcohol for 15 seconds and the dehydration rapidly completed in 95 per cent. and absolute. Sections were cleared in neutral xylol and mounted in neutral balsam.

Dehydration must be rapid so that cyton areas do not become completely destained. After washing in 80 per cent. alcohol the sections will become reddish in color with blue cyton areas. If the dehydration is properly carried out, the following structures will be selectively and permanently stained:

Cytons and Nissl granules deep blue; nuclei of blood vessel structures and neuroglia light blue; elastic fibers of blood vessels deep blue; erythrocytes pink; and neuroglia fibers light red.

The intensity of the cyton stain may be increased or decreased by varying the proportion of the Giemsa solution in the mixture.

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A RAPID METHOD FOR REMOVING COVER GLASSES OF MICROSCOPE SLIDES

IT is often necessary in cytological work to remove the cover glass of a slide, in order to replace a broken cover glass or restain the sections underneath. For this purpose most workers use xylene. The writer, however, has found that a mixture of 90 parts of xylene and 10 parts of n-butyl alcohol acts much more rapidly. The hard and brittle balsam or damar of old slides, which would require an immersion of several days in pure xylene, is usually dissolved by this mixture in a few hours. This time difference is probably due to the presence—especially in old slides—of a small amount of moisture in the mounting medium around the margin of the cover glass. Such moisture would offer a barrier to the penetration of pure xylene, but not to xylene containing n-butyl alcohol; for the latter is miscible with small amounts of water, as well as with xylene, balsam and damar. It should be remembered that butyl alcohol is a solvent of the aniline dyes, and so material stained with these substances will be destained in this xylene-butyl alcohol mixture.

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SPECIAL ARTICLES

X-RAY DIFFRACTIONS FROM HEMOGLOBIN AND OTHER CRYSTALLINE PROTEINS

SEVERAL attempts have been made during the past years to get x-ray diffraction photographs of the crystalline proteins. Most of these[1] have not been successful, but in a few instances very simple patterns have been observed.[2] These patterns, which always consisted of two rather broad and diffuse rings, have been found from proteins as different as edestin, excelsin, egg albumin and hemoglobin.

The diffuseness of the rings, combined with their simplicity irrespective of diffracting substance, suggests the pattern of a glass or other amorphous material rather than of a crystal. The probability that they are such amorphous patterns is strengthened by the recent statement[3] that a typical sharp line pattern can be prepared from a single crystal of pepsin left in its mother liquor.

We have been seeking to obtain truly crystalline powder patterns from edestin, excelsin and hemoglobin. Photographs prepared in the usual way from (1) commercial edestin, (2) well-crystallized edestin and excelsin freshly made from hemp seeds and Brazil nuts and (3) crystalline (white rat) oxy- and carbon monoxy-hemoglobin gave the familiar "amorphous" bands. When these preparations were examined microscopically they proved to be more or less completely altered after photography. Further microscopic study demonstrated that the protein crystals always decomposed rapidly on exposure to air. From the way this disintegration took place it was clear that they all contained water of crystallization which was very readily lost.

Photographs with copper K radiation were accordingly made of the wet crystals sealed into thin containers having windows of 0.01 mm glass. Under such conditions the protein crystals remain unchanged and typically crystalline patterns, consisting of fine, though very faint, lines, are produced. With this experimental arrangement reflections corresponding to large spacings lie too close to the central image for accurate measurement. Additional, and far more instructive, photographs have consequently been made with the longer chromium K radiation by keeping samples in moist chambers without protective windows. Some spacings thus measured on typical pictures of rat oxyhemoglobin are listed in Table I. There is no reason to believe that we have yet established the largest spacings that exist for this hemoglobin or for the other protein crystals. Our techniques, however, are being improved and it is expected that these maximum spacings will eventually be determined.

[1] For example, R. O. Herzog and W. Jancke, *Naturwiss.*, 9: 320, 1921; W. H. George, *Proc. Leeds Phil. Soc.*, 1: 412, 1929.

[2] See J. R. Katz, "Die Röntgenspektrographie als Untersuchungsmethode" (Berlin, 1934), p. 188.

[3] J. D. Bernal and D. Crowfoot, *Nature*, 133: 794, 1934.

TABLE I

SPACINGS OF SOME POWDER LINES OF OXYHEMOGLOBIN

Spacing	Estimated intensity	Spacing	Estimated intensity
45.7 A	s (broad)	10.4 A	m
27.5	m	9.4	f
21.7	m–	8.4	f
18.0	ff	5.93	ff
15.4	f	4.90	ff
13.0	m	4.62	f
11.6	ff	3.47	ff

In this table s, m, f, ff represent strong, medium, faint and very faint. It is possible that one or two of the fainter lines are beta reflections.

In the meantime it may be concluded that:

(1) The proteins edestin, excelsin and hemoglobin crystallize with water of crystallization, which is very readily lost. The band pattern previously described as common to these and other proteins is produced by apparently amorphous materials resulting from the efflorescence of the crystalline compounds.

(2) If care is taken to prevent the decomposition of their crystals, these proteins give typical powder patterns rich in sharp lines. Some of the observed spacings are much longer than those found from insoluble protein structures like silk, hair and tendon.

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EFFECTS OF THEELIN ON THE MALE GENITAL TRACT

THE principal known action of theelin (ketohydroxyoestrin) is to induce tissue proliferation in the accessory genital organs of the female. This has been demonstrated in the usual laboratory animals; the monkey and man. Since an oestrus-inducing agent has been extracted from the urine of normal human males[1] it seemed desirable to study the action of theelin on the male genital tract. Some changes have been described in the mouse[2] and rat[3]; and in the male monkey it is known that this oestrogenic extract is responsible for a sexual skin reaction.

The effects of interest here have been brought about by the subcutaneous injection of 60 cc of theelin[4] over a period of thirty-four days into an immature monkey weighing 2,450 gms at autopsy. A cage of similar age, weighing 3,000 gms at autopsy, used as a control. The most striking change growth was found in the seminal vesicles, those of injected animal weighing 5½ times as much as those the control. Histological study showed the increase entirely due to muscular hypertrophy of the walls the vesicles. There had been no stimulation of secretory epithelium, and the lumen of the individual tubule had fewer outpocketings than the control. It appears that the activity within the wall had restricted concurrent increase in lining epithelium. The ejaculatory ducts were enlarged. Within the prostate there was also a relative increase in fibromuscular stroma at the expense of the epithelial glands. As in the prostate of the adult castrate monkey, where the epithelium is markedly degenerated, the prostate takes a more posterior position in relation to the urethra. Another striking tissue change was found in the prostatic utricle where extensive cornification of the epithelium had taken place increasing the thickness of the epithelium as much as twenty-five times.

The prostatic utricle is a remnant of the Müllerian ducts and as such the change here is analogous to the well-known effect in the vaginal mucosa. In view of this the report of a similar effect[2] in the posterior prostatic lobes of the mouse may indicate that these lobes are not true prostate but have an origin in common with the utricle. In the monkey this cornification extended along the posterior wall of the urethra into the membranous portion and the columnar epithelium of the pars cavernosa had become cornified.

Notwithstanding the great development of the scrotal sac the right and left testes (which had not increased in size) lay in the groin 3.5 cm and 2.5 cm respectively, from the external inguinal rings. There was incontinence of urine and the usual swelling of superficial tissues about the distal portions of the genital tract.

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[1] E. Laqueur, E. Dingemanse, P. C. Hart and S. E. de Jongh, VI Mitteiling *Klin. Wchnschr.*, 6: 1859–1868, 1927.

[2] Harold Burrows and N. M. Kennaway, *Am. Jour. Cancer*, 20: 48–57, 1934.

[3] John Freud, *Biochem. Jour.*, 27: 1438–1450, 1933.

[4] Through the courtesy of Dr. Oliver Kamm, of Parke, Davis and Company, we have received theelin for this study.

BOOKS RECEIVED

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